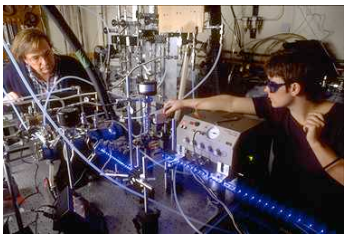
NOAA Earth System Research Laboratory
Chemical Sciences Division
…understanding the chemistry of our atmosphere



Chemical Sciences Division scientists conduct laboratory experiments to help improve NOAA's predictions in climate, air quality, and ozone-layer depletion.

The NOAA WP-3D and DC-3 research aircraft and the NOAA R/V *Ronald H. Brown* become "mobile chemical laboratories" to study atmospheric processes in air quality and climate field studies organized by the Chemical Sciences Division and involving colleagues in other NOAA Research laboratories and other agencies and universities.

Chemical Sciences Division scientists and their colleagues discovered the atmospheric chemical processes that cause the Antarctic ozone hole. Division scientists continue to study the chemistry and processes associated with the recovery of the stratospheric ozone layer and the interactions between ozone depletion and climate change.

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What does the ESRL Chemical Sciences Division do for the nation?

The research of the Chemical Sciences Division (CSD) provides a sound scientific basis for decisions and choices made by industry, government, and the public relating to climate change, air quality improvement, and ozone layer protection.

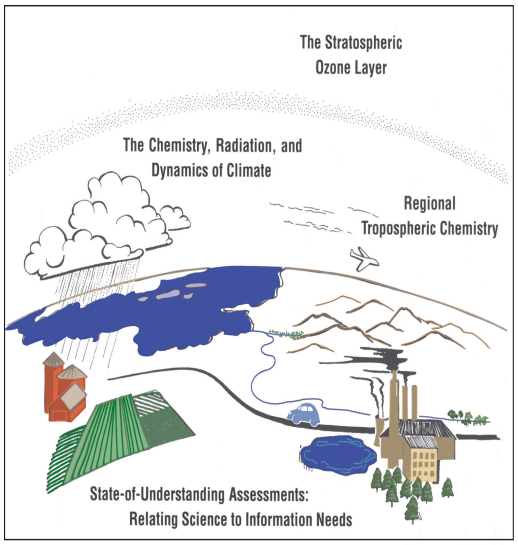
The mission of CSD is to:

- conduct scientific research aimed at understanding and quantifying the processes that govern the chemical reactions of Earth's atmosphere;
- contribute process-level chemical understanding that improves modeling predictions of regional and global phenomena, which lie at the heart of NOAA's mission;
- communicate scientific information in "user-friendly" terms to NOAA's customers in government, industry, and the public.

Chemical reactions and radiative processes (heating, cooling, and initiation of reactions) drive atmospheric change. Identification and characterization of these processes are needed for building better models of the atmosphere. CSD focuses on understanding the chemical reactions and radiative processes that are important to model predictions of past and future changes in climate, regional air quality, and the stratospheric ozone layer.

In this context of helping to build better predictions, CSD scientists conduct investigations of atmospheric chemistry under controlled conditions in the laboratory, make field measurements in a variety of environments, and carry out diagnostic analyses and interpretations. The Division also assists the scientific community worldwide in providing decision-support information. CSD provides leadership and scientific input to efforts to assess the current state of scientific understanding and interacts with those who use this information. For example, CSD personnel serve as co-chair of the climate-science working group of the Intergovernmental Panel on Climate Change (IPCC) and as co-chair of the international ozone-layer scientific assessment for the U.N. Montreal Protocol.

Recent Accomplishments:



- Used a new instrument developed at CSD to obtain the first chemical "fingerprint" of the *individual* aerosol particles that can cause cloud formation. ***Payoffs: By identifying the chemical makeup of the less than 1% of ambient particles that are effective ice condensation nuclei, this research will improve the capabilities of NOAA's Climate Program to predict cloud formation and its climate and radiative implications.***
- Discovered new factors that cause ozone pollution in the Houston area, showing that leaks of reactive gases from the petrochemical refineries prevalent in the region were a much, much larger factor than had been expected. ***Payoffs: These research results have altered the policy approach taken by Texas air quality managers, at an estimated savings of 64,000 jobs and $10 billion for the State by the year 2010, and are helping the State to better plan its air quality improvement strategy.***

- Demonstrated that the observed pattern of recent Antarctic surface temperature trends (cooling over the high plateau, accompanied by warming in the region of the Peninsula) is largely due to a change in Southern Hemisphere circulation that is related to the ozone hole. ***Payoffs: This research has helped to lay the scientific foundation for international decisions to better protect the climate as well as the ozone layer.***
- Played extensive roles in leading, authoring, reviewing, editing, and/or publishing international scientific state-of-understanding assessments on the climate system, fine-particle pollutants, and the stratospheric ozone layer. ***Payoffs: These information products provide key scientific input to pending national and international decisions regarding these three societally relevant topics.***

What's next for the Chemical Sciences Division?

CSD scientists provide Program Management leadership for NOAA's Air Quality Program and within NOAA's Climate Research and Modeling Program, and they lead assessment efforts that provide user-friendly information for decision makers in climate and air quality. Over the next five to ten years, CSD will focus on:

- **Climate**

  Climate Change: Chemical Composition, Radiation, and Clouds
  - understanding the role of aerosol particles and processes in atmospheric heating/cooling, cloud formation and composition, and the alteration of atmospheric chemical composition
  - defining the role of intercontinental transport and chemical transformation in regional atmospheres and in global climate
  - understanding the radiative effects of water vapor and trace gases in the atmosphere
  - determining the contributions of individual (geographic, sectoral, etc.) emissions to climate forcing and air quality change, and elucidating impacts of climate change on air quality

  Stratospheric Ozone Layer Recovery
  - determining how climate change will affect the ultimate recovery state of the ozone layer and the timing of its recovery, and how changes in the ozone layer affect climate
  - evaluating the "ozone friendliness" and "climate friendliness" of proposed substitutes for the now-banned ozone-depleting compounds
- **Air Quality**
  - identifying the factors (such as nighttime chemistry and sea-to-land transport) that contribute to ozone pollution in various regions of the U.S. that are experiencing poor air quality
  - determining the measurements and diagnostic analyses that are needed as the scientific foundation for NOAA's air quality forecasting capabilities
  - identifying regionally-dependent factors that influence the formation of atmospheric fine particles and their chemical composition across the chemically-diverse U.S.

Our NOAA Niche: Understanding and quantifying atmospheric chemical and radiative processes to underpin NOAA's global models, and providing user friendly, policy-relevant scientific information on climate and air quality to NOAA's information customers in government, industry, and the public.

Research Partnerships

Several CSD scientists are affiliated with the Cooperative Institute for Research in Environmental Sciences (University of Colorado) or the Cooperative Institute for Research in the Atmosphere (Colorado State University). CSD also has vital research and scientific partnerships with colleagues from other Divisions of the Earth System Research Laboratory, other NOAA/OAR laboratories, NOAA's National Weather Service and National Environmental Satellite Data and Information Service, NASA, NSF, U.S. Department of Energy, U.S. Environmental Protection Agency, private industry, and numerous universities and organizations worldwide.

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